The use of *Bacillus thuringiensis* and Neem alternation on *Plutella xylostella* (Lepidoptera: Plutellidae) and its effects on natural enemies in cabbage production

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Introduction (1)

- Cabbage is an important economical crop in the world, it is a source of income and food
- In West Africa for instance, the annual production of cabbage is estimated at 140500 tons (FAO)
- Production of cabbage is constrained by various insect pests among them *Plutella xylostella* (Lepidoptera: Plutellidae), diamondback moth (DBM)

Introduction (2)

- The cost of pest control is estimated to US $ 1 billion each year
- Chemical control is the most commonly used control method despite its environmental and health issues
- DBM has developed resistance to many synthetic pesticides

Introduction (3)

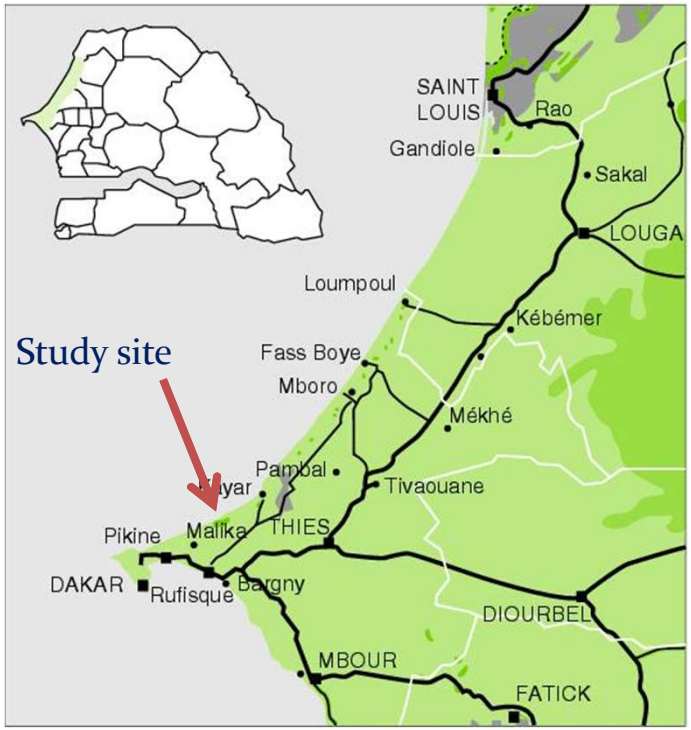
***Bacillus thuringiensis* (*Bt*) and Neem-based products are considered as relevant alternatives to synthetic chemical insecticides.**

The objective of this study was to determine:

- **the effect of the alternation of *B. thuringiensis* and neem-based agrochemicals on DBM populations**
- **and its repercussions on natural enemies abundance and their parasitism**

Materials and methods (1)

- **Study site (Malika): 12°54'44,2"N and 12°08'08,4"NW**
- **Yearly précipitations : 500 mm max.**
- **T°C: 20 - 30°C**



Materials and methods (2)

- Cabbage *Brassica oleracea* variety "*Marché de Copenhague*"
- Furadan applied in the soil prior to planting
- Transplanting done one month after seedlings
- Total plots: 35
- Cabbages / elementary plot: 60
- Total cabbages in field : 2100

Randomized complete block design

N: Neem; **B**: Biobit; **N/B**: alternation Neem and Biobit; **Tt**: Diméthoate; **T**: Control; **B1-B7**: Blocks with treatments

Materials and methods (3)

Four (4) treatments were used :

- **B : biobit** (*Bacillus thuringiensis* var. *Kurstaki* (EC)
- **N: neem** (Suneem, *Azadirachta indica* 1% EC)
- **N/B: alternation Biobit/Neem**

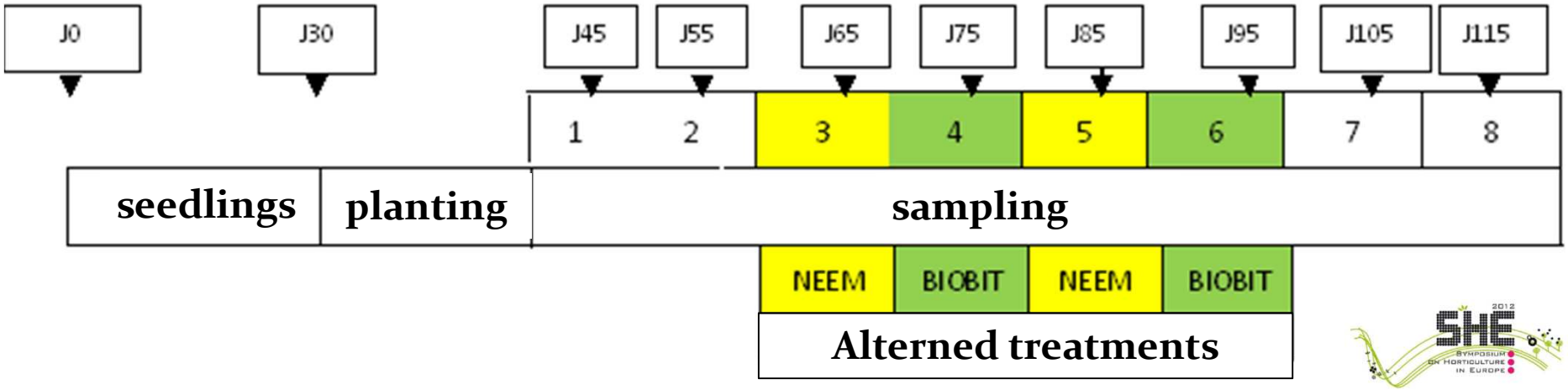
(in 10 days interval four times)

- **Tt: diméthoate** (Meteor 400 EC)
- **T: untreated control**

Materials and methods (4)

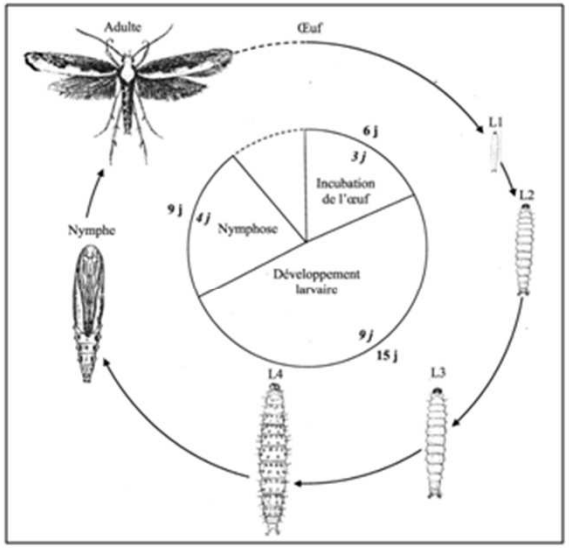
- **Applications started 25 days after planting**
- **For N, Bt, Tt and T treatments, crops were normally treated using a manual sprayer every ten days.**
- **For the alternated treatment N/Bt, only four (4) applications of Neem and Biobit were used. Neem was applied first and the last application was Biobit. Alterned treatment was stopped 20 days before application of the other treatments.**

Scheme of the alternation Neem/Biobit treatment



Materials and methods (5)

Life cycle of *P. xylostella*



Cycle de développement de *P. xylostella* à 20°C (à l'extérieur du cercle) et à 25°C (à l'intérieur du cercle) (valeurs en jours, Salinas, 1986) (dessin : Carpenter, 2005)

Materials and methods (6)

Sampling of DBM in field

- Samplings started 10 days after transplanting and were performed every ten days. Samples were collected randomly by selecting 10 cabbages in the central rows of each plot
- Second, third, and fourth instar DBM, pupae and parasitoid cocoons were collected and taken back to the laboratory and left to develop in order to determine abundances and parasitism rates within the different treatments.

Materials and methods (7)

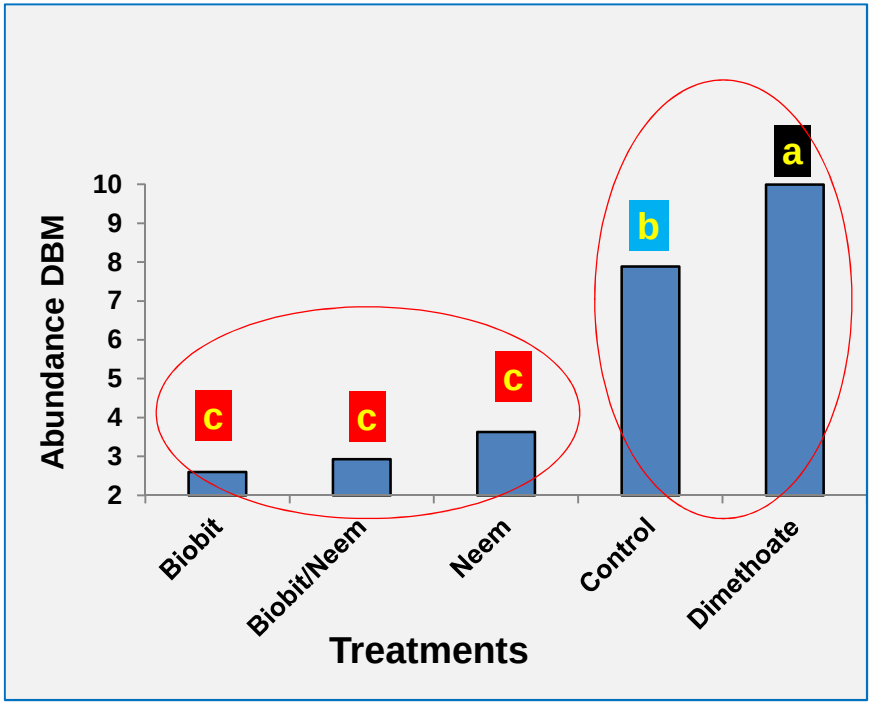
Statistical analysis

- Data were normalized and subjected to ANOVA
- Means were separated by Students Newman Keuls Test.
- Pearson correlation test was also used
- Parasitism rate was calculated using Mc Cutcheon formula (1987) :

$$\% \text{ Parasitism} = \frac{[\text{Number of parasitized mothes}]}{[\text{Total number of mothes} - \text{Number of dead mothes}]} \times 100$$

Results and discussions (1)

Effect of treatments on the abundance of *P. xylostella*



Means not bearing the same small letter are significantly different using ANOVA SNK 5%.
Legend :
N: Neem; **B**: Biobit; **N/B**: alternation Neem and Biobit;
Tt: Diméthoate; **T**: Control

- Plots treated with Dimethoate hosted the highest number of DBM larvae
- Compared to plots treated with Dimethoate, plots treated with Biobit, Biobit/Neem and Neem recorded say three times lower number of DBM larvae.
- The alternation of Biobit and Neem could offer better prospects to farmers as it reduces significantly the level of infestation of DBM after four applications only.
- This technique can contribute substantially in the reduction of the occurrence of resistant strains among DBM populations (Reddy, 2011).

Results and discussions (2)

Effect of treatment on the parasitism of *P. xylostella*

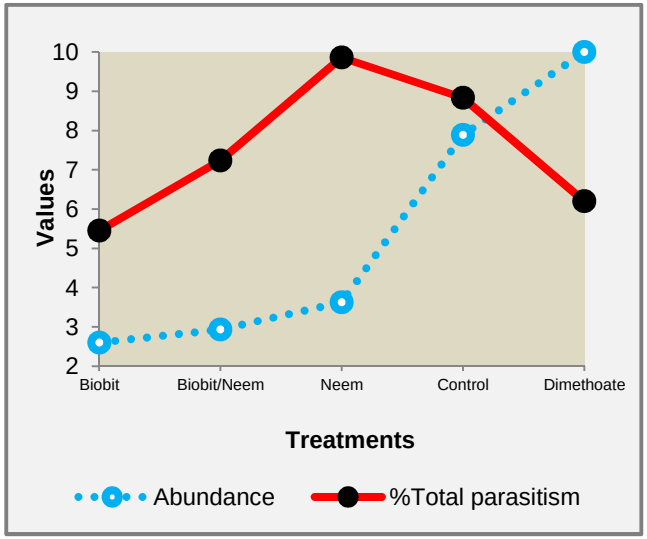
Treatments	Mean parasitism *	O. sokolowskii	A. litae	C. plutellae	B. citrea
Control	8.833ab	2.905a	5.513a	0.594ab	0.000a
Biobit	5.451b	1.382a	4.069a	0.000b	0.000a
Biobit/Neem	7.238ab	1.598a	5.448a	0.000b	0.192a
Neem	9.862a	1.467a	7.337a	0.995a	0.064a
Dimethoate	6.197ab	0.904a	5.238a	0.260ab	0.256a
	(F=2.6; P=0.03)	(F=1.6; P=0.15)	(F=1.5; P=0.17)	(F=3.6; P=0.006)	(F=0.8; P=0.5)

In column values bearing the same small letters are not significantly different in ANOVA, SNK at 5%.

Mean parasitism rate of *O. sokolowskii*, *A. litae*, *C. plutellae* and *B. citrea* on *P. xylostella* in cabbages treated with Biobit, Biobit/Neem, Neem and Dimethoate. *: overall

Results and discussions (3)

Pearson's correlation coefficient test between *DBM* abundance and the parasitism



- There was a significant correlation between the abundance of *P. xylostella* and parasitism in the treatments Biobit, Biobit/Neem, Neem and control.
- The correlation was stronger in the Biobit/Neem treatment.
- However, the correlation was not significant in the chemical treatment with Dimethoate

	Biobit	Biobit/Neem	Neem	Control	Dimethoate
Observed value	0.144	0.323	0.287	0.181	0.096
Two-tailed p-value	0.004	< 0.0001	< 0.0001	0.000	0.057

Conclusions

- These results showed that alternation of Biobit and Neem with only four timely applications appears to be more promising for DBM management.
- The method is not harmful to parasitoids populations and their potentiality to reduce DBM populations.
- Alternation of *Bt* and Neem can be recommended in integrated pest management programs for DBM as it is also cost-effective and achievable by farmers.

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MERCI !